Contact-less communication system

ABSTRACT

Apparatus for providing a contact-less, bi-directional communication link between a power supplying module (PS) and a power consuming module (PC) having at least one inductive link used for power, clock, and upstream data transfer as well as a downstream data link. The said downstream data link can be implemented either as a second inductive link in the system, or as an optical link. All of the inductive links used in the system are separable and can be easily disengaged. The first inductive link (L1), used for transferring electrical power between the PS and the PC, has a separable high frequency transformer with a primary coil permanently mounted to the PS and a secondary coil mounted on the PC. The PS includes a power supply circuit comprising of a ferrite core transformer and capacitor forming a parallel resonant circuit, while a simple rectifier is mounted on the PC. The primary coil of said transformer is driven by a voltage-controlled amplitude modulator, which provides an input of variable amplitude to the drivers in order to cause them to alternately increase or decrease the voltage induced in the secondary coil of L1. Those said variations of the induced voltage are detected and used in the PC as the means for the upstream data link. Said L1 is also used to provide the clock to the PC by tapping the non-rectified voltage directly from its secondary coil. The downstream data link (from the PC to the PS) can be implemented through the use of a second inductive link (L2), which in this case utilizes another separable high frequency transformer; a primary coil permanently mounted on the PC and a secondary coil mounted on the PS. The data is transmitted from the PC to the PS by tapping a signal from the secondary coil of L1. The non-rectified signal from the secondary coil of L1 is passed to the primary coil of L2 via a crossbar switch, which can alternate the polarity of the signal being fed into the primary coil of L2. Thus the phase of the voltage being induced in the secondary coil of L2 can be changed with respect to the voltage being fed into the primary coil of L1. This phase relationship can be detected in the PS by comparing the two signals and this provides the means for the

downstream data transfer. Alternatively, the downstream data link can be implemented using an optical communications link; the optical transmitter on the PC and the optical receiver on the PS. In this case, the data is transferred using AM modulation of the light beam.

CROSS-REFERENCE TO RELATED APPLICATIONS

For example, parent U.S. Pat. No. 4,654,573, discloses a Power transfer device, wherein the apparatus for transferring electrical power between a power supplying apparatus and power consuming apparatus and having a separable high frequency transformer with a primary permanently mounted to the power supply apparatus and a secondary mounted about the power consuming apparatus. The power supply apparatus includes a power supply circuit comprising a ferrite core transformer and capacitor forming a parallel resonant circuit. A driver drives the primary coil of the transformer. Power is transferred across the inductor to the resonant circuit as portions of a sine wave. The power supply circuit also includes an internal current sensing circuit to shut current build-up down when current in the resonant circuit becomes too high, and an external control loop which senses power demands of the charging control circuit delivered via an optical communications link within the separable transformer. This technique provides the user with efficient means of contact-less power transfer from one device to another. The method described in U.S. Pat. No. 4,654,573 allows not only power to be transferred but describes means to provide clocking of the power consuming apparatus as well as a feedback data link. Unfortunately the U.S. Pat. No. 4,654,573 does not teach how to build an efficient bi-directional data link between both apparatus. An obvious problem of the method described in U.S. Pat. No. 4,654,573 is that the return data path requires significant energy consumption from the power consuming apparatus. It requires at least one LED to be powered on and thus effects the overall power balance of the system.